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GB 2235893 A

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**(54) Electrodischarge drilling**

(57) Drilling a hole through a wall of a hollow component into a cavity within the component by electro discharge machining so as to protect a far wall of the cavity from the electro discharge is carried out by injecting a molten non-electrically conductive wax into the cavity, permitting it to solidify, and carrying out the drilling until a change in the acoustic emission of the electrode as it enters the wax is detected. The drilling is then stopped, the electrode withdrawn, and the wax removed by steam.

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DRILLING HOLES IN COMPONENTS

This invention relates generally to drilling holes in components, and in particular to drilling a hole through a wall of a component into a cavity within the component by means of electro discharge machining, without damaging a far wall of the cavity.

Modern developments in gas turbine engines for use in aircraft require the generation of a high temperature gas stream within the engine, which in turn requires the use of special techniques to keep components, such as blades, that are in contact with the hot gas stream, at a temperature below that of the gas stream.

One of these techniques is to provide the component, which for convenience but without limitation we shall herein exemplify as a turbine blade, with a hollow interior or cavity, a series of small bore cooling holes passing from the cavity to the outer surface of the blade, and a continuous supply of cool pressurized air within the cavity, whereby in use cool air is forced out through the cooling holes over the outer surface of the blade and thereby protect the blade from the high temperature of the hot gas stream.

The cooling holes are of small diameter and, to fulfil their purpose, must be very accurately located, machined and drilled. One way of providing cooling holes having such requirements is by the known technique of electro discharge machining, which we shall hereinafter refer to as "EDM".

A problem arising out of the use of EDM to drill holes into a cavity in a blade is that of the EDM electrode impinging on the far wall of the cavity being drilled

into, with possible consequent damage not only to the electrode but to the far wall of the cavity. Damage to the wall of the cavity may have a deleterious effect on the air flow through the cavity and may possibly weaken the structure of the blade.

Hitherto, attempts to deal with the problem of far wall impingement have been by detecting breakthrough of the EDM electrode by electrical means, or by insertion of a metallic impingement guard into the cavity. Both these methods are inconvenient in that they either require the use and control of relatively expensive electrical detection apparatus, or the provision of purpose-made metallic inserts. Metallic inserts are not always possible if the cavity is of an awkward shape, and there remains the danger that the EDM electrode may be damaged by contact with the insert.

According to the present invention there is provided a method of drilling a hole through a wall of a component into a cavity within the component by means of electro discharge machining, the method comprising the steps of, (a) injecting a molten non-conductive material into the cavity so as to fill the cavity, (b) permitting the material to solidify within the cavity to a relatively soft consistency, (c) drilling a hole through a wall of the component into the cavity by means of an electro discharge electrode, (d) detecting breakthrough of the electrode into the material within the cavity, (e) withdrawing the electrode from the component, and (f) removing the material from the cavity.

Preferably, the material is a wax, and may be removed from the cavity by steam cleaning.

The breakthrough of the electrode into the cavity may be

detected by observing a change in the acoustic properties of the electro discharge as the electrode contacts the material within the cavity on breakthrough.

In an example, the cavity in a hollow gas turbine blade was injected and filled with a molten wax which was then allowed to solidify. A hole was drilled into the cavity through the wall of the blade by means of an electro discharge machine electrode. Breakthrough of the electrode into the cavity was observed by an audible change in the sparking noise of the electrode as it contacted the solidified wax within the cavity.

Drilling was then stopped and the electrode withdrawn from the blade. The wax was then removed from the cavity by the application of steam which steamed out the wax.

Inspection revealed that there had been no impingement of the electrode on the back wall of the cavity, and no damage to said back wall.

The wax was seen to have served four purposes:

(1) It protects the back wall of the cavity from the electro discharge machining because it is non-conductive.

(2) It allows the electrode to continue some way into the cavity and to widen the exit point of the hole into the cavity, and slows down the rate of travel of the electrode, thus enabling breakthrough to be detected more easily.

(3) It does not damage or bend the EDM electrode.

(4) It produces an audible difference on breakthrough as it absorbs the "sparking noise" of the EDM electrode.

A material other than a wax may be used provided it is non-conductive or aprotic, solidifies when applied, and is easily removed by the application of heat or a hot solvent.

The method of the invention may be applied to the drilling of holes into cavities of components other than hollow turbine blades.

CLAIMS

1. A method of drilling a hole through a wall of a component into a cavity within the component by means of electro discharge machining, the method comprising the steps of, (a) injecting a molten non-conductive material into the cavity so as to fill the cavity, (b) permitting the material to solidify within the cavity to a relatively soft consistency, (c) drilling a hole through a wall of the component into the cavity by means of an electro discharge electrode, (d) detecting breakthrough of the electrode into the material within the cavity, (e) withdrawing the electrode from the component, and (f) removing the material from the cavity.
2. A method as claimed in claim 1 wherein the material is a wax.
3. A method as claimed in claim 2 wherein the wax is removed from the cavity by steam cleaning.
4. A method as claimed in any preceding claim comprising detecting breakthrough of the electrode into the cavity by observing a change in the acoustic properties of the electro discharge as the electrode contacts the material within the cavity on breakthrough.
5. A method of drilling a hole through a wall of a component into a cavity within the component substantially as herein described with reference to the example.

Patents Act 1977  
Examiner's report to the Comptroller under  
section 17 (The Search Report)

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Relevant Technical fields

(i) UK CI (Edition X ) B3V

(ii) Int CI (Edition 5 ) B23H

Databases (see over)

(i) UK Patent Office

(ii)

Search Examiner

D N P Butters

Date of Search

23 May 1991

Documents considered relevant following a search in respect of claims

ALL

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2235893 A (ROLLS ROYCE)	1, 2, 3

SF2(p)

3TPABF

Category	Identity of document and relevant passages	Relevant to claim(s)

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